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The sea ice model LIM: a new subgrid-scale coupling scheme with NEMO and other recent developments

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The first part of the presentation will be dedicated to the "multi-column ocean" (MCO) scheme that allows a subgrid-scale coupling between LIM and NEMO. With this new scheme, the heterogeneity of ocean surface conditions associated with a spatially variable sea ice cover can be represented in the model, and the sensitivity of the latter to subgrid-scale ice-ocean interactions can be assessed. LIM includes an ice thickness distribution, which provides heterogeneous buoyancy fluxes and stresses at the ocean surface. The MCO scheme is developed to take them explicitly into account, by computing convection and turbulent vertical mixing separately in the open water/lead fraction of grid cells and below each ice thickness category. For the first time in a three-dimensional simulation, the distinct temperature and salinity profiles of the ocean columns are allowed to be maintained over several time steps. It is shown that the model response is highly sensitive to the homogenization time scale between the columns. If the latter are laterally mixed with time scales shorter than 10 h, subgrid-scale effects exist but the mean state is practically unaffected. For longer mixing time scales, in both hemispheres, the main impacts are reductions in under-ice mean mixed layer depths and in the summer melt of sea ice, following decreased oceanic heat flux at the ice base. Large changes in the open water temperature in summer suggest that the scheme could trigger important feedback processes in coupled simulations. In the rest of the presentation, recent, current and future developments of LIM will be highlighted.